The Benefits of Single-Touch Screens in Intersubjective Meaning Making

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Abstract: What are the benefits of single-touch screens? The paper presents findings of one video extract from ten months of observation of single-touch screen interaction among 8-9 year-old children. Recent studies of collaborative learning mediated by digital touch screens and tabletops emphasize the possibilities for equal levels of verbal and physical participation. Additionally, these studies suggest that multi-touch technologies offer more task-oriented activities compared to single-touch screen interaction, in which discussion about turn-taking is more prevalent from the outset. In contrast, applying the Embodied Interaction Analysis, we find that the constraints of single-touch screens offer support for intersubjective meaning making in their capacity of constraining the interaction. This "grain of sand" shows how children display and construct a shared work space through embodied interaction with a single-touch screen.

Introduction

Within the CSCL community, researchers from a variety of disciplines seem to agree that new interactive multi-touch technologies might afford new possibilities for collaboration and participation among co-located peers (Dillenbourg & Evans, 2011; Mostmans, Vleugels, & Bannier, 2012; Rick, Marshall, & Yuill, 2011; Rogers & Lindley, 2004). Additionally, experimental and design related studies have highlighted these possibilities (see related work section) during the past 10 years. Nevertheless, Yuill & Rogers (2012) state that despite the many positive attributes of multi-touch technologies, these affordances might not support smooth collaborative learning. Likewise, pedagogical considerations on how to best implement these technologies in classrooms are still scarce, and most importantly, data from "natural" classroom settings in the form of video footage are few. With this in mind, we present our main research question for this paper; do single touch-screens offer support for children's intersubjective meaning-making in collaborative activities? Basically, we study how children negotiate and cultivate a "local rationality" (Heap, 1995), and in our analysis we focus on language, gestures and materials in the children's co-located activities with the single-touch screens. We want to know what benefits single-touch screens offer to children in their co-located collaborative learning.

Related work

Three general approaches to research have been identified in CSCL: experimental and conditional studies, iterative design studies, and descriptive studies (Stahl, Koschmann, & Suthers, 2006). So far, research on collaborative learning mediated by interactive touch-screens and tabletops has been studied mostly from the first two research perspectives. The third category of research is not, on the other hand, widely represented within this area, and we argue that descriptive studies can produce important insights as to the contributions of (single) touch screens to intersubjective meaning-making. Consequently, this study intends to "explore and understand" rather than "code and count".

Experimental and conditional studies on interactive multi-touch tabletops suggested that this kind of technology can support collaboration, more equal forms of participation, and speedier conflict resolution (Hornecker, Marshall, Dalton, & Rogers, 2008; Rick et al., 2011). For example, Rick et al. (2011) presented work on three dyads working with DigiTile at the back of a classroom. Rick et al. subscribed to the common belief regarding the affordances of interactive tabletops, i.e. awareness of each other's actions and concurrent parallel work. Finally, Rick et al. suggested that enforcing equitable physical participation can disrupt the dynamics of collaborative activities. In another paper, Harris et al. (2009) reported a difference between multi- and single-touch technologies. His overall conclusion was that in the single-touch setting children talked more about turn taking, and in the multi-touch setting talk was more oriented towards the task at hand. In this experimental setting, the children were asked to make a seating plan for their classroom, and they were provided with information about the different pupil groups in order to make a successful seating plan. Likewise, Higgins et al. (2011) have compared the use of multi-touch tables with paper based tasks in a tabletop environment and suggested that the use of multi-touch tables is more conducive to the creation of a joint problem space in collaborative learning tasks. These results are based on numbers of touches and utterances.

From a design approach Yuill & Rogers (2012), Dillenbourg & Evans (2011) and Scott et al. (2003), to name but a few, have presented guidelines to support the integration of touch-technologies in learning settings. Scott et al. devised 8 system guidelines for co-located collaborative work on a tabletop. Among other things, they suggested that the technology should support natural interpersonal interaction, flexible user

arrangement and simultaneous user interactions. Dealing with design and the implementation of touch screens for classroom teaching, Dillenbourg & Evans proposed 33 points for consideration when integrating touch tables into educational settings. The third design framework from Yuill & Rogers draws on social psychology theories of learning in their identification of three mechanisms that influence collaborative learning. These three are: *high awareness of others' actions and intentions, high control over the interface, and high availability of background information.* Additionally, Yuill & Rogers criticized the commonly perceived affordances of how the "natural" interaction with touch-technologies influences participation and collaboration in positive ways.

To repeat, the experimental approaches taken on interaction with various touch-interfaces attended to amount of talk, number of touches in an activity and the layout of the shared workspace in co-located peer-to-peer activities. The design related studies presented a mixture of abstract and concrete guidelines for the use of touch-technologies in collaborative activities. On the basis of our findings in these related papers, we suggest that a descriptive analysis of children's embodied interaction will shed light on the benefits of single-touch screens in meaning making in co-located learning projects. By means of a descriptive approach using video footage our aim is to uncover the methods that children use to accomplish learning (Stahl et al., 2006).

What do you mean by meaning making?

Intersubjective meaning making is our analytical focus in this paper. Intersubjective meaning making concerns the ways in which actors construct, display and maintain individual and shared perspectives of the task at hand. Matusov (1996) has outlined a series of questions regarding the study of intersubjectivity: what is involved in the process of intersubjectivity, what is the dynamics of it, and how is this process embedded in larger-scale practices and community life? These are core questions to work with if we want to understand intersubjective meaning making as a dialogue between peers, their gestures and use of materials. Several illustrations of this can be found in (Streeck, Goodwin, & LeBaron, 2011), where researchers present the way in which embodied intersubjective meaning making is unfolding across a variety of settings. Particularly, the way in which intersubjective meaning making is manifested and developed in the situation, and a certain local rationality (Heap, 1990) is formed. Likewise, Koschmann and LeBaron (2002) used different examples to illustrate that learner articulation is a verbal, gestural and material phenomenon. These three semiotic resources are intertwined and mixed in the process of intersubjective meaning making. In other words, these semiotic resources inform one another and "talk back" to each other. Analytically, the study of intersubjective meaning making is founded in traditions such as Conversation Analysis and Interaction Analysis. In our case, intersubjective meaning making is a combination of language, body, and materials in human-computer interaction. This concept is widely referred to as Embodied Interaction by Dourish (2004) and Streeck, Goodwin, and LeBaron (2011). As a consequence of this, our analysis of co-located children interacting with a single-touchscreen is focusing on the way in which the children are making sense in the activity through embodied actions. Particularly, the way in which a word, an artifact or a bodily gesture embodies the situated meaning making process. To sum up, we study how children are using various semiotic resources to make sense in front of single-touch screens.

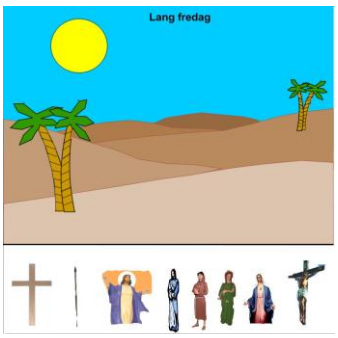
A peek into the classroom setting

Throughout one year, researchers collected a variety of qualitative data from two classrooms in a Danish school. We refer to Davidsen and Georgsen (2010) for a general introduction to the project. In this setting, single-touch screens were integrated to augment children's learning activities (1). The single-touch condition offers one item of input at a time, which is a constraint from a technological point of view. In total, 8 23-inch single-touch screens were distributed in two classrooms. Besides three teachers, 41 pupils (8-9-year old 2nd graders) participated. The pupils were working in pairs, using 23-inch single-touch screens with Internet access and with Smart Notebook software installed. In this setting, we collected more than 150 hours of video data from 7 different positions. Overall, this data consisted of three modes of interaction: verbal (e.g. children talking), gestural (e.g. children pointing at the screen, each other or the materials) and direct manipulation (e.g. children touching and moving objects on the screen). These modes of interaction are mediated by semiotic resources, and our focus is to study the interplay between the different semiotic resources. Moreover, we have studied the teachers framing of the children's collaborative activities in front of the screen. In Koschmann, Stahl, and Zemel's (2007) vocabulary, this learning setting is shaped by the children's embodied interactions and sense making processes and vice versa.

What are the benefits of single-touch screens?

From the body of video data, we have chosen one extract of 22 seconds for this paper (2). This particular extract contains many of the typical findings from the data material. Moreover, the extract provides a good example of the benefits of single-touch screens to intersubjective meaning making in classrooms. As our analysis shows; meaning making takes place among semiotic resources. For example, the two pupils display, produce and maintain an intersubjective understanding of the activity through language, gestures and the single-touch screen.

This can be described as embodied collaborative actions. The situation we have selected is from the final part of the project, when the novelty of the touch screens has decreased. Awareness of collaborative actions, on the other hand, has been a part of the classroom activities for almost 10 months now.



Snapshot 1. Scene


Snapshot 2.Iris (I) and Vince (V)

We follow Iris (left) and Vince (right). They are in the middle of producing a multimodal story about what happened on Good Friday. The kids wear headsets in order to listen to their production and make adjustments to their story. This video story is the final product of their work. Before they began their collaborative activity, all pupils in the class have talked about religious traditions, they have read about Good Friday in pairs of two, tested their knowledge in a multiple choice quiz and rewritten the story in their own words. Finally, they have to transfer their acquired knowledge into a video production, using the collaborative software on the single-touch screen. According to the teacher, the children themselves decided how to construct a meaningful story based on the previous activities during the week. This learning material was designed by the teacher as a six-staged script. The overall objective of this script was to teach the children about the Christian tradition of Easter, the training of language skills, and storytelling skills. For this paper, we focus on the final stage, namely the task of retelling the story in a video production by using the figures and the scene (see snapshot 1). In this situation, the children are rehearsing their video production, reading aloud the text and moving around the objects on the screen. The children have written their account of the story about Good Friday in the booklet in Vince's right hand. The figures and scenery (snapshot 1) they have to use to make the production were designed by the teacher. Before the activity started, the teacher showed the whole class how to use the collaborative software and the video screen recorder. However, the teacher did not give any instructions as to how to carry out the collaborative work in the pairs. Vince and Iris, the pair we are concentrating on in this paper, initially started to discuss who should read aloud the text and move around the figures accordingly. After a short discussion, they decided to divide the work between them, and agreed to swap after the first rehearsal in order for both of them to try moving around objects and reading the story aloud. Vince is reading the text in this episode. During the rehearsal, Vince was not able to follow what Iris was doing on the screen while he was reading their story from the booklet. Immediately after they finished their first rehearsal, Iris discovered that they were missing an object to cover Jesus. Hence, they agreed to make a rock. This means that they were in fact reconfiguring the original scene made by the teacher. What the children have noticed is that there is a discrepancy between the words of the story and the scenery designed by the teacher. It is a small difference that interrupted their activity. This breakdown in their rendering of the story influenced their reasoning about the material they are working with. The pair's reconfiguration was based on their knowledge from the story, and this became the object of their meaning making process. To sum up, this story showed that interaction with single-touch screens can be a highly social activity in terms of language, gesture and manipulation of objects on the screen. Additionally, our analysis showed that the children are taking over and repairing each other's actions on the screen.

The findings from our analysis suggest that single-touch screens impose a constraint that forces children into a process of collaboration and negotiation. At the beginning of this project, we saw the single-touch condition creating much frustration and individual work at the shared computer. In the situation analyzed in this paper, however, we see that the pupils have developed a practice of collaboration, which on the one hand allows them to push forward their own idea while still maintaining a state of intersubjectivity. For example, the girl clearly reserves room for action, while disagreeing in her verbal communication. The shared space for interaction with their hands offers, and in this case even links, verbal interaction and movement together as fluent argumentation. Furthermore, this clip shows that the side-by-side positioning offers room for meaning making. In case of multi-touch, we expect that the girl would have touched the screen and started her manipulation without offering space, room, and time for the boy to finish his action.

Discussion

On the basis of our findings we argue that the constraints of a single touch-screen facilitate collaborative learning. By the same token, our findings indicate that having to share a workspace, despite the inevitable annoyance of not having your own, can lead to the establishing of rutines of turn taking, co-viewing and co-manipulating, which in the end can lead to intersubjectivity. Moreover, the side-by-side position, the single-touch condition, and the vertical position create a room for shared meaning making. As a result of this, we argue that researchers and teachers should consider whether single or multi-touch facilitates collaborative learning better. With the short sequence featuring Iris and Vince, we illustrated the way in which two children were making sense through language, gestures and with the material as a shared reference. The pair were prompted to reconfigure the scene to match their story. From our perspective, the missing rock was an important feature of the learning material. This discrepancy led the children to discuss and reinterpret the scene. This is where meaning making happens.

Ahead of us lie new technological developments that will influence the ways in which we learn and work. It might be tempting to trace the ever changing realm of technology. For example, invest in multi-touch tables or tablets for every individual learner in the schools. As we demonstrated in our analysis, the single-touch condition adds a seemingly interesting constraint that supported collaborative learning in this setting. We argue that researchers need to look for mechanisms of collaboration (e.g. Yuill and Rogers (2012)) in other settings in order to design touch technologies and learning materials that promote intersubjective meaning making.

Notes

(1) Names of each child, teacher and the school have been changed.
(2) Visit http://people.hum.aau.dk/~jackd/CSCL13/ to view the video and transcript analysed in this paper.

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